New England Regional Climate Change Impacts on Recreation and Tourism

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Recreation and tourism is a major part of New England's economy. Using New Hampshire as an example, this sector of the economy resulted in $2.5 billion dollars in direct spending and 1.5 billion in indirect spending in 1994, which represented 9.5% of the gross state product. Outdoor recreation is a very significant part of this business. The 28 New Hampshire alpine and nordic ski areas resulted in $190 million in direct spending, $18 million in tax revenues, and another $319 million and $48 million in secondary spending and taxes, respectively. The Appalachian Mountain Club (AMC) operates a series of backcountry huts and facilities and cooperatively maintains hiking trails within the White Mountain National Forest, NH. A 1995 report indicated that AMC's activities alone resulted in some 662,746 visitor days, generating nearly $63 million in economic activity.

For perspective, tourism ranks third behind manufacturing and retail in terms of bringing money into NH, accounting for 12% of the total employment and 7% of the state's taxroll. Within region's of the state, such as the White Mountain's, tourism is the most important export industry. In this area tourism will continue to increase in importance with the decline of the major manufacturing jobs in the paper and wood industry that once dominated northern NH. Visitor days to the White Mountain National Forest in NH have grown from 2.8 million visitor days in 1975 to an estimated 7 million in 1995. These trends are not unique and mirror themselves in the neighboring states of Maine, Vermont and New York.

The recreation and tourism business in New England is highly dependent on several factors including the weather, the health of the region's ecosystems and the economy. Climate change can impact this industry in both obvious and more subtle ways. Alteration of the physical climate such as temperature, precipitation and storm patterns greatly influence the willingness of people to take a vacation and the length of that vacation. Snowless winters in much of the region can set the mood for the large skiing population in the southern part of the region to not venture north. It also greatly increases the cost of snowmaking which can exceed $750,000 per year for a major ski area. Cross-country skiing and snowmobiling, other important components of the winter tourist economy, become almost non-existent during low snow winters such as occurred in the early 1980s. Similarly the very hot and smoggy summer of 1998 saw fewer people venturing into the mountains due to the uncomfortable heat and humidity and poor visibility.

Changes in the physical environment may also negatively impact the ecosystems which draw people to a region to recreate. Unique natural resources are a particularly strong draw for tourists, such as the alpine areas for their unobstructed views and relatively uncommon vegetation communities. In what is one of the most populated regions of the US, today there are only about 13 square miles of alpine habitat in the eastern US all remnants of the glacial era of years bygone. The largest alpine ecosystem is the Presidential Range in the White Mountain National Forest that includes Mount Washington, followed by Mt. Katahdin in Maine and much smaller units in the Green and Adirondack Mountains. It is estimated that some 250,000 people annually ascend Mount Washington, the region's highest mountain. Unfortunately the northeast's alpine ecosystems are some of the most threatened by climatic change, they are relatively small and isolated meaning natural processes for recolonization would be extremely slow.

Moderate warming can result in the of migration of plant species. Alpine species in high mountains can be pushed upwards in elevation and be eliminated if already at mountain summits. During this century warming trends in western Austria and Switzerland are correlated with the displacement of alpine plants at the rate of about 3 13 feet elevation per decade. Most at risk in New England would be the smaller alpine areas all those in the Adirondack and Green Mountains and, excluding Mount Washington and Katahdin, all others in NH and ME. Monitoring the treeline alpine ecotone

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boundary may serve as one of the best indicators of plant community response to climatic change. The AMC has begun a monitoring program to measure alpine vegetation shifts on Mount Washington and the Presidential Range, NH.

Alteration of the chemical climate, that is variations in the chemical composition of the atmosphere and precipitation, also have direct impacts on recreation and tourism. Ozone, though a natural and needed chemical in the atmosphere's upper stratosphere, is a manmade pollutant in the lower troposphere with serious global warming, ecological and health implications. Ozone, a primary ingredient in urban smog, is four times more effective as a greenhouse gas than carbon dioxide, is now increasing in the atmosphere at the same annual rate as carbon dioxide, and currently is estimated to contribute about 8% to global warming. Ozone smog formation is not only enhanced by warmer, sunnier conditions, but it also can travel long distances from urban into rural areas.

Ozone has serious health implications particularly for the young and those with asthma or heart problems. Eastern mountain summits and the coastal regions such as Bar Harbor, Maine, some of the most important tourist regions in New England, are particularly prone to and now commonly experience long-distance ozone transport episodes. AMC has monitored ozone on Mount Washington's summit for over a decade, where values commonly surpass those in the surrounding lowlands and have exceeded national health standards. Preliminary results from a study by the AMC, Brigham and Women's Hospital and the Harvard School of Public Health (currently being peer-reviewed for publication) suggest that prolonged outdoor exercise by hikers exposed to low-levels of ozone, fine particle (PM 2.5) and strong aerosol acidity is associated with significant effects on lung function among adults. On Mount Washington and its surrounding peaks it is estimated that some 60,000 people hike. Studies like these only add to the reason for smog alerts and warnings that people should not exercise outdoors on certain days, particularly on warmer summer days. In summary many rural tourist destination areas are no longer exempt from smog impacts, in fact ozone advisories have been expanded from urban weather forecasts to some eastern National Parks as well. The impacts of these evolving chemical climatic conditions are not selling points for a tourist region's brochure or its economy.

Suspended particles and droplets in the atmosphere may counter some effects of global warming, by reflecting sunlight back into space. But they add little to New England's health or tourist business, with the exception of giving prettier sunsets. In the northeast many of these fine mass particles are anthropogenic in origin, can stay suspended for lengthy periods and have a large fraction containing sulfates or acid aerosols. These fine mass particles contribute to acid rain and cloud events.

Given the abundance of scenic vistas, visibility is important to the White Mountains and many other tourist regions. Ongoing studies by AMC, the White Mountain National Forest and the Harvard School of Public Health link visibility impairment with fine mass particles in the White Mountains. Preliminary results from a 1996 study indicate that forest users can consistently perceive changes in visibility reduction related to fine particle concentrations in the atmosphere.

In an earlier 1988 AMC survey, respondents were asked to look at pictures depicting different visibility conditions in the White Mountains that were selected from clear to hazy conditions caused by fine mass particle pollution. Sightseers indicated that as visibility impairment increased, almost 53% would curtail their activities. 86% of the respondents found the transition in visibility from unpolluted to polluted to be undesirable. Much of the public incorrectly attributed hazy, low visibility conditions to humidity and not fine mass particles. An ongoing study by AMC and a UNH Ph.D. candidate is now focused on the economic value individuals place on visibility in the White Mountains.

Clearly there are numerous other implications of how changes in the physical and chemical climate can influence the region's tourism and recreation. The fall foliage season is one of the region's biggest seasonal draws, attracting visitors from around the world. This colorful display and the related tourist business is highly susceptible to changes in annual weather patterns. The survival and range of the tree species which make New England's colors some of the most dramatic in the world, particularly sugar maples, are dependent on climatic conditions.

Similarly, fishing is a cornerstone and very important economic part of the outdoor recreation industry in New England. For the region, some 2 million people devoted 24 million days to fishing and spent an estimated $1.3 billion in 1991, many coming from out of state. The fisheries is susceptible to not only chemical changes as acid rain, which can eliminate species, but also changes in water temperature. In central and northern New

England fishing for species dependent on colder waters such as trout and salmon is one of the largest economic segments of this recreational industry. Alterations in streams chemistry or the warming of pond, lake and stream temperatures could greatly reduce habitat available for the region's economically important and very sensitive cold water fisheries.

Upwind sources of emissions are a very important factor impacting the quality of New England tourism and indirectly its climate. But the recreation and tourism industry in New England is also very dependent on a highly mobile public using the automobile as its primary source of transportation to travel long distances. Automobiles are a significant source of the chemical precursors that form ozone; their combustion of fossil fuels also makes major contributions to increased carbon dioxide levels. In searching for solutions, the recreation and tourism industry needs to actively seek ways to reduce its contribution to the climate change problem, not just look for scapegoats.